

small-scale maps, the true position is not likely to lie within the thickness of the stroke which marks it, and deviation means change of area. Finally, we have the vast uncertainty of the utterly unknown Antarctic and Arctic regions, which are estimated by Wagner to amount to 16,000,000 and 5,000,000 square kilometres respectively, or together 4 per cent. of the whole earth's surface. In the face of all this uncertainty, does it not seem that only the balancing of errors can give an approximation to the truth regarding the areas of land and water; and that from the circumstances of the case, the fact that one set of estimates disagrees with another, independently made, is of small account? While every precaution should be taken to exclude errors of computation or of typography, it may be affirmed as a principle, that to subject uncertain data to a too rigorous discussion is waste of labour. Round figures alone can be justified for many a long day in estimating the areas of the earth's surface, and for longer still in estimating the volumes of oceans and continents.

The contour-lines on any ordinary map of a continent are only the roughest generalisation of the height, even when numerous points of altitude are fixed by exact levelling. But where a whole continent, like Africa, is measured for volume by the few barometer and boiling-point altitudes which have been taken by travellers of varying skill and in unknown meteorological conditions, the most laborious calculation can only be an elaborate guess. The temerity of the map-draughtsman in laying down the contour-lines of the oceans is justifiable as the expression of probability, not as any exact delineation. In the Atlantic they may indeed be guessed at with some confidence, but in the Pacific and Southern Oceans the mean depth might easily be hundreds of fathoms greater or less than is supposed from the scattered points which have been measured as yet.

It is right to guess at mean measurements, and to reason hypothetically from them, but there is a risk of men accustomed to critical rather than to practical work being misled against their knowledge by the firm lines of maps and the means of ingeniously grouped observations. That Prof. Wagner has obtained the best results possible by means of his calculations we recognise with sincere pleasure, but he has had the good, though naturally imperfect, work of others to start from, and a reader of his criticism might be led to disparage those workers but for whom the ambitious attempt to calibrate the earth's inequalities might have been postponed for another century.

For myself I gladly accept the new value of the mean-sphere-level as better than the avowedly rough guess which I hazarded six years ago. And although Prof. Wagner calls me "a friend of round figures," with a touch of rebuke in his tone, I shall still try to deserve the name in connection with such calculations until the improvement of geographical measurements justifies the use of decimals in percentages, and fifties of fathoms in average oceanic depths.

HUGH ROBERT MILL.

THE WORK OF LOCAL SOCIETIES.

THE practical methods of modern biological research have been developed to such a high state of perfection since the introduction of the appliances of physics and chemistry, that the system of training in biology has within a comparatively short period undergone a complete revolution. As one result of this change the student is tempted from the fields and hedgerows, from the downs, heaths and woodlands, from the banks of streams, and from the sea-shore into the laboratory. He knows the structure of a certain number of "types," but he walks as a stranger among the living animals and plants that surround him. His knowledge is not of that kind attributed to the wise king who "spake of trees, from the cedar-tree that is in Lebanon, even unto the hyssop that springeth out of the wall: he spake also of beasts and of fowls, and of creeping things, and of fishes." The organism is to the modern student not a living entity having a beautifully adjusted relationship to its environment, but a complicated collection of tissues capable by appropriate treatment of being spread out into a panorama of thin slices. His acquaintance with the living plant or animal is of about the same kind as that which a chemist ignorant of mechanics would acquire by endeavouring to understand the working of a watch by making a chemical analysis of its wheels and springs. In brief, the extreme specialisation of laboratory work begins too early in his curriculum. Since the introduction of the system of instruction by "types," there has arisen an estrangement between the old school of field naturalists

and the modern biologist—a result which was not anticipated by the founders of this system, and against which a healthy reaction, led by Mr. Thiselton-Dyer and others, is beginning to take place.

It is true that certain departments of biology have gained enormously by the introduction of modern methods, and it must also be admitted that some branches, such as morphology and physiology, are best dealt with in laboratory and dissecting-room. But at the same time it is to be deplored that the department which Prof. Ray Lankester has happily termed "bionomics" should be allowed to suffer by competition with the new methods. If biology has gained in some directions, it is certainly the case that as a subject for the scientific training of the observing faculties, it has suffered deterioration by leaving the field naturalist outside the pale. The latter, finding himself threatened with scientific excommunication, is driven into the pages of popular magazines, or writes books which, although often very pleasant reading, are painfully sterile from the purely scientific point of view, and most disappointing when the capabilities of the writers are taken into consideration. Between the cabinet systematist who studies nature in museums, on the one hand, and the laboratory worker, who ignores the animal or plant as a living organism, on the other hand, the student of the old school of natural history is being hard pressed to find a footing. In a country like ours, with its immense colonies and dependencies in every quarter of the globe, it is most regrettable that our educational authorities do not recognise field natural history as a subject worthy of their most serious encouragement.

While the modern development of biological teaching has led to the result above indicated, the local societies of this country have, in an unpretending way, been doing good work by keeping alive the spirit of the old school of naturalists. There are now on the list of Corresponding Societies of the British Association sixty-three societies distributed over the United Kingdom.¹ All of these are more or less actively engaged in carrying on local observations in various fields of science, and their very existence is good evidence that there is a store of available energy in this country which is by no means a negligible quantity in estimating the scientific status of the nation. Field natural history forms a large part of the work of these societies, and this is certainly one of the directions in which every encouragement should be given by all who are interested in their welfare. Under field natural history would be included the collecting and recording of species so as to furnish materials for the compilation of local faunas and floras, observations on the habits and life-histories of individual species, the systematic recording of dates of appearance of species, &c., comprised under the general subject of phenological observations. The local societies have already done much work in these subjects, and much more remains to be accomplished. In connection with the collecting of specimens it might be well to point out that these societies can do an enormous service by discouraging on every occasion the unnecessary destruction of life—by teaching by precept and showing by example that the mere acquisition of specimens is not the end and aim of natural history work, and that when a typical collection has once been formed the needs of science have been met. Most particularly is the assistance of the local societies wanted in protecting the "lower orders" of the animal kingdom and the rare species of plants from the depredations of the "dealer" or the avarice of the collector, for while our birds are now likely to flourish under a beneficent Act of Parliament, it is impossible to make a public appeal to the argument from sympathy with sentient beings in the case of the invertebrate classes of animals, or in the case of the rare plants which still linger in unfrequented districts. These are cases for appeal to scientific reason rather than to sentiment. Is it too much to hope that the societies in each district should approach the landowners on whose estates rare species are known to occur, and invite them to co-operate in securing the protection of our choicest forms of animal and vegetable life?

In many other directions is there scope for useful scientific work on the part of local observers.² In geology, for instance,

¹ The total number of members registered as belonging to these societies is nearly 24,000. It is of course difficult to arrive at the actual numbers, because the same member may belong to more than one society; but after making every allowance for such repetitions, it will be seen that the volunteer army of scientific workers is much stronger than has hitherto been realised.

² For some valuable suggestions with respect to meteorological work, see the address to the Conference of Delegates at the last (Ipswich) meeting of the British Association, by Mr. G. J. Symons, F.R.S., Chairman of the Conference.

temporary sections are often exposed, which a resident in the district might take the opportunity of sketching or photographing and describing while the chance is open to him. Such opportunities are frequently lost owing to the temporary character of the work which has necessitated the excavation, and the absence of a qualified observer at the right time. It cannot be made too widely known to the members of local societies that every extensive artificial excavation is worth calling the attention of geologists to, and particularly when the society comprises no geological expert in its own ranks, because external aid might then be solicited before it is too late.

There are also certain special lines of geological work in which local co-operation has been found of great value, such, for instance, as the recording of the rate of erosion of sea-coasts, the distribution, mode of occurrence, mineralogical characters, &c., of erratic blocks, the height of water in wells, and so forth. These investigations have been, or still are being, carried on by British Association Committees, and are mentioned here simply as illustrations of the kind of work in which the members of local societies might take part. In anthropology and prehistoric archaeology there is also abundant scope for local effort in the way of registering ancient remains, conducting systematic explorations, and assisting in their preservation by the appointment of vigilance committees. The needs in this department of science have been set forth in the reports of the British Association Ethnographic Survey Committee, and have from time to time been referred to in these columns in the reports of the conferences of delegates of Corresponding Societies.¹

Thus, while there is plenty of work for local observers to do, and while the efforts which have been made in the past, and which are still being made by the provincial societies are worthy of the highest commendation, it cannot be denied that the energies of our local workers are not altogether as productive as they might be made for the cause of science. To point out a few of the reasons why the scientific activity of local societies is not producing the best possible results in the way of original investigation, may go some way towards suggesting remedies. In the first place, there is very frequently a want of co-operation between workers in the same or in neighbouring districts. This leads to a frittering away of energy by several people doing the same thing independently and unnecessarily. Such want of co-operation often arises from petty local jealousies which, however contemptible, may be powerful enough to cripple progress. Perhaps the best way to ensure co-operation is to bring the societies of the same or neighbouring counties into occasional intercourse by means of a system of federation. The Unions of naturalists' societies, such as those of Yorkshire, the Midlands, and the East of Scotland, have done good service in this way. As we have already announced, a Congress of Societies of the South-east of England was held at Tunbridge Wells on April 25. On a wider scale the British Association has for the last eleven years been giving facilities to the representatives of local societies all over the country for meeting and holding annual conferences under the official auspices of the Association. Not the least important feature of these conferences, which are regularly reported in these columns, is the opportunity which they give the delegates of learning directly from scientific experts the particular lines of work in which local co-operation is likely to be of real value to science. The work of some of the Association Committees has in this way received considerable local support, but on the whole the assistance given is not as great as could be wished. It may be useful to attempt an analysis of the causes why such aid has not been more freely rendered.

Any one who looks into the publications of local societies, or who is acquainted with the details of their management, must become impressed with the fact that the greater part of the work is done by amateurs. We do not use this term in a disparaging sense; on the contrary, it redounds to the credit of this country that so much work should be done by amateurs. But the workers of this class, however enthusiastic, are often devoid of scientific training, and are still more generally prevented by other occupations from carrying on continuous observations in any one subject. Hence the sporadic character of the work published, the want of co-ordination, and the difficulty of getting adequate assistance for the systematic recording of observations required by the prolonged inquiries undertaken by the British Association Committees. Another weakness which the amateur

often possesses is the tendency to cope with too wide a range of subjects, and a desire to take in hand the whole circle of the sciences rather than devote himself to the drudgery of detailed observation in one limited field. Much good would result if it could be brought home to those who really desire to further the cause of science by local work, that the united efforts of a number of workers, each labouring in his own little domain, is in the long run the best of all methods for advancing knowledge by original contributions. If the amateur would curb his ambition, and take counsel with his co-workers, the volumes of some of the publications which have come under our notice would shrink in size, but the literature of science would gain considerably thereby.

The most promising remedy for these and other defects which are incidental to associations composed of more or less fluctuating elements appears to be the system of federation, if it can only be effected practically so as to over-ride the petty local narrowness which so frequently prevails. By co-operation the general level of the work done would be raised; it would be made more obvious to each worker that the cause of science is the one determining influence that should bind together the members of the society and the society to the Union. Numerous other advantages would naturally follow the adoption of such a course. Not the least important of these is the improved status which each society would gain by being affiliated with its neighbours. If the status is raised more support might be looked for from the wealthy county residents, who, although not themselves personally concerned with scientific work, might feel it a duty to encourage the county society. It may be pointed out incidentally that one of the most frequent causes of the collapse of local societies is the want of pecuniary support. This at least is the proximate cause; but the ultimate cause in such cases is as often as not the diminishing activity of the society itself, and the consequent loss of interest in its proceedings. It is confessedly difficult to keep up continuous active interest among such fleeting associations of members as compose the rank and file of the local societies. Many join at the foundation, carried in by a wave of temporary enthusiasm which soon dwindles down to an evanescent ripple, ending in the dead calm of indifference and ultimate secession. Or, again, the officials who float the society with all the enthusiasm of novelty may leave the district, or, worse still, kill the creation of their youth by the decrepitude of old age, and by tenaciously holding office convert the association into "a one man society" with a fossilised official for its executive. Truly it has been said that a local society is just what its secretary likes to make it. With federation and co-operative action there would arise a stimulating influence tending to prevent the decline of any one of the federated societies through these or any other of the thousand natural causes that affect the healthy existence of such associations. There would also be added to these beneficial effects an increased element of stability and permanence, more particularly if the societies constituting the federation were bound together by having one common publication. With respect to this last suggestion, there is everything to be said in its favour from the point of view of economy, from the point of view of avoiding the unnecessary duplication of editorial work, and, not least, from the point of view of diminishing the amount of printed matter which the scientific reader is now supposed to assimilate.

Many other aspects of the work of local societies might have been dwelt upon with advantage, but this want of centralisation appears to be one of the chief causes why their scientific productivity is not commensurate with the number of workers scattered throughout the country. We should like to see the whole of the British Islands parcelled out into groups of counties, each group being represented by a federation of all the societies contained in the counties composing the group. Such Unions are wanted, for example, by the South Eastern, the South Western, and the Western counties, as well as by East Anglia and other naturally associated groups of counties which will suggest themselves. The formation of these Unions would not only strengthen the societies already in existence, but would lead to the establishment of other societies in districts that were not already provided for. There is no reason why, in view of all the available scientific energy which is known to exist, the local society should not become a real power in each district—a centre of intellectual enlightenment worthy of public recognition and support in the same sense that every other

¹ See an article by the writer, in *NATURE*, vol. xxix. p. 19 (1883).

county institution has a claim upon the county residents. The foundation and maintenance of local museums is distinctly a part of the work of the local societies; in so far as these museums can be utilised for educational purposes, they have a claim to support from the County Councils, and in a few cases such support has actually been given. We note with satisfaction that the London County Council in the estimate for the expenditure by its Technical Education Board for the ensuing year has allocated a certain sum to "museums." The county of Essex is, we believe, unique in having attached to its Technical Instruction Committee a certain number of representatives of the local society. In agricultural and maritime districts where technical instruction centres round the sciences which are more particularly cultivated by the local societies, there is no reason why there should not always be co-operation between these societies and the County Councils. If such co-operation is at present the exception rather than the rule, it is because the local societies have not made their influence as intellectual powers felt with sufficient force. Let these societies knit up their scattered units, let their amateur workers be educated up to the necessity for carrying on systematic instead of casual observations, let them court the respect to which their labours entitle them by putting forth good evidence of activity, and they may play a far greater part in the scientific development of this country than has hitherto fallen to their lot. R. MELDOIA.

CAMPHOR.

CAMPHOR is not the exclusive product of any one natural order, genus, or species; but what is more remarkable, of closely allied species of camphor-yielding genera—one species possesses the secretion, while no trace of it is found in another. Although several kinds of camphor are articles of commerce, little, if any, reaches this country, save that obtained from *Cinnamomum camphora* (*Camphora officinarum*), a member of the laurel family, and of the same genus as the tree whose bark furnishes the spice called cinnamon. Like many other natural products of which scientific research has multiplied the applications, camphor is becoming dearer and scarcer, and the question has arisen, How is the supply to be maintained equal to the demand? The bulk of the camphor imported into Europe comes from Japan and Formosa, and comparatively little from China. This is the product of *Cinnamomum camphora*, and Dr. E. Grasmann has published¹ an interesting account of this tree, both from a scientific and commercial standpoint. He has rather overweighed his article with second-hand information respecting laurels generally and those of Japan in particular, which, as might be expected, is inaccurate in some details. Disregarding these, we find much that is interesting concerning the camphor-tree itself, which is one of the noblest objects in the forests of eastern sub-tropical Asia. It attains gigantic dimensions, surpassing all other trees of the Japanese forests, at least in girth of trunk if not in total height. Dr. Grasmann gives the recorded dimensions of various notable trees, but what is more to the point, he also gives measurements made by himself. A tree in the neighbourhood of the town of Miyazaki, Oyodomura, measured in 1894, was 14.80 metres in circumference at 1.30 m. from the ground, or 4.48 m. in diameter, and it was 35 m. high. There is an illustration of this giant reproduced from a photograph. Concerning the distribution of the camphor-tree in Japan, the author states that it grows naturally in Kinshin up to about 34° lat., and scattered in favourable situations some 2° farther north, the extreme limit being 36° 24'. It is abundant in the island of Formosa, and also occurs in the Tsusima and Luchu groups. On the mainland of China, according to Dr. Grasmann, it inhabits the coast region from Cochin-China to the mouth of the Yangtze-kiang, and it may be added that it is now known to extend westwards at least as far as Ichang in the central province of Hupeh. From Dr. A. Henry's notes accompanying his specimens in the Kew Herbarium, it appears that the wood is in great request, but no camphor is extracted; and Consul Playfair reported the same from Pakhoi, Kwangtung, in 1883. Indeed the camphor industry would seem to be at present very limited in China, although the tree is common and widely spread. The little that is exported is

mostly from the province of Fokien, but the amount is increasing in the same measure as the production is decreasing in Japan. In the latter country something has been done to maintain the supply, but Dr. Grasmann holds that the present rate of planting is wholly inadequate. He urges the importance of increasing the plantations to the greatest possible extent, inasmuch as every part of the tree is useful, from the roots to the young shoots and leaves. Even the fruit is employed in the preparation of tallow. In Formosa camphor distilling has been carried on in the most recklessly extravagant manner imaginable. It is suggested that Japanese rule in the island may put a stop to such disastrous waste.

With regard to the increasing price of camphor, it has been stated in various publications that this is due to its being used in the manufacture of smokeless powder. In reply to inquiries on this point, Sir Frederick Abel wrote to the Director of Kew in November last as follows:—

"Any increase of demand, involving a rise in the price of camphor, is not due to its application as a constituent of smokeless powder. That material was used in the earliest days of the manufacture of a successful smokeless powder for artillery and small arms; but its employment was soon demonstrated to be attended with serious practical disadvantages, and its application for the purpose can therefore not be said to have been other than experimental, and of no great importance, even at that time, as affecting the market value of camphor. This substance has, however, been used extensively for many years past, and no doubt in continually-increasing quantities, for the conversion of collodion cotton into the material known as celluloid, which is applied to the manufacture of imitation ivory, tortoiseshell, horn, and a great variety of purposes."

As Dr. Grasmann observes, the greatest enemy of the camphor-tree is man, and in Japan large trees are eventually killed through the felonious nocturnal grubbing of their roots. Some trees are fond of the fruit and seed, and the caterpillar of *Papilio sarpedon* feeds on the leaves; but, except to young plants, they cause comparatively little damage. Apart from the wanton destruction of trees, the probability of the supply of camphor being maintained is seriously diminished by the fact that the tree grows but slowly in its early years. At the same time it colonises freely, and is now naturalised in several countries, notably in Madagascar, where, according to Dr. Meller, in a note accompanying a specimen in the Kew Herbarium, it was abundant as long ago as 1862, and was much used for building purposes.

Next in point of importance in producing camphor is *Dryobalanops aromatica*, a tree belonging to the Dipterocarpeæ, and inhabiting Borneo and Sumatra. The formula of ordinary camphor is $C_{10}H_{16}O$; of Borneo camphor, $C_{10}H_{18}O$; and the latter can be artificially prepared from the former. Borneo camphor is deposited in clefts and hollows of the wood, and has simply to be taken out; but it is comparatively rare, and exceedingly dear, bringing eighty times more, according to Grasmann, than ordinary camphor. Nearly the whole production is imported into China, where it is esteemed beyond the ordinary camphor, and used as incense.

Blumea balsamifera (Compositæ), a shrubby plant exceedingly common in tropical Asia, yields a kind of camphor by distillation. Hainan is the principal seat of the industry, but the crude article is refined at Canton, whence there is an annual export of about 10,000 pounds. No doubt this source of camphor could be much more extensively utilised.

Members of various other natural orders, notably the Labiatæ, yield essential oils of the same composition, and having the same properties, as camphor. Menthol is an example.

W. B. H.

URANIUM.

THE introduction of the electric furnace by M. H. Moissan as an instrument of research, has opened up many new fields of work; among which the preparation of those metals whose oxides had been looked upon as irreducible by carbon, is not the least interesting. Three years ago the metal uranium was obtained in this way, and in a recent number of the *Comptes rendus* (May 18), M. Moissan gives a more complete account of the preparation and properties of this metal. The metal was isolated by three methods, by the action of sodium at a red heat upon the double chloride of sodium and uranium, $UCl_4 \cdot 2NaCl$,

¹ "Der Kampferbaum. Mittheilungen der deutschen Gesellschaft für Natur- und Völkerkunde Ostasiens in Tokio," vi. pp. 277-315, with illustrations. 1895.